Juvenile Squirrels Need Some Stress Hormone to Learn

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Research at the University of Chicago shows that young squirrels learning to survive in their environment need a moderate level of stress hormones. The study points toward the role of stress hormones on early learning in humans. Credit: University of Chicago

Tests on the influence that a stress-related hormone has on learning in ground squirrels could have an impact on understanding how it influences human learning, according to a University of Chicago researcher.

Jill Mateo, Assistant Professor in Comparative Human Development, has found that when they perform normal survival tasks, ground squirrels learn more quickly if they have a modest amount of cortisol, a hormone produced in response to stress, than those with either high or low levels

of cortisol.

In humans, cortisol production is also related to stress and is known to have an impact on learning, but that impact is not well understood, Mateo said. The research on ground squirrels could point to additional avenues of research.

In order to survive, ground squirrels must adapt quickly and learn how to navigate the dangers of their environment so they can find their way back to their burrows. Ground squirrel pups typically emerge from their burrows about the time they're weaned, at four weeks of age.

"Two hundred can emerge at the same time, providing a feast for predators," said Mateo, who studies Belding ground squirrels, native to high elevations in the western United States. In nature, about 30 percent of pups do not survive.

Modest levels of cortisol are apparently linked to their survival, Mateo reports in the article, "Inverted-U shape relationship between cortisol and learning in ground squirrels," published in an on-line posting of the journal *Neurobiology of Learning and Memory*. The "inverted U" is the shape data forms on a chart. Animals with low levels of cortisol are at the left of the inverted U, and those with high levels are at the right, while those with modest levels and higher learning are in the middle.

In order to test whether animals with low levels have difficulty learning, Mateo simulated a natural setting with a maze and connected it with a box that contained a nest of squirrel pups. She noninvasively altered the amount of coritsol in the pups' systems and found that those with both high and low cortisol levels took an average of 13 to 14 trials before they navigated the maze, while a control group of non-treated pups with a modest amount of cortisol needed just nine.

She tested the animals' response to danger by throwing a Frisbee over the maze and also by sounding a bird call to see how quickly the pups responded. High and low amounts of cortisol reduced the animals' ability to learn how to respond to danger.

Among humans, what research that has been done on cortisol and learning has been inconclusive. Unlike animals, researchers cannot moderate cortisol levels in humans to study its impact. However, scholars are aware of situations in which cortisol levels change due to unusual interventions and events.

For instance, in order to help women at risk of pre-term birth deliver healthy babies, doctors sometimes treat them with synthetic glucocorticoids, which raise cortisol levels. The glucocorticoids facilitate fetal lung development.

"We know almost nothing about the neurobiological implications of these treatments on cognitive development of children," she said. Animal studies have shown that these treatments can have negative effects on brain development, she said.

The animal tests also help to understand the potential human impact of low cortisol on learning, she said.

Source: University of Chicago